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Bertone et al.

[11] **3,902,963**

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[54] **ANTI-EJECTION LATCH**

[75] Inventors: **Louis A. Bertone**, Tariffville, Conn.; **Peter F. Behmke**, Swansea, Mass.

[73] Assignee: **Combustion Engineering, Inc.**, Windsor, Conn.

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[52] **U.S. Cl.** ..... **176/36 R**; 310/14

[51] **Int. Cl.** **G21c 7/08**

[58] **Field of Search** 176/36; 310/12, 14; 74/527

[56] **References Cited**

UNITED STATES PATENTS

3,066,763	12/1962	Brussalis, Jr. et al.	176/36 R
3,158,766	11/1964	Frisch	310/14
3,299,302	1/1967	Frisch	310/14
3,445,690	5/1969	Thorel et al.	310/14
3,480,807	11/1969	Downs et al.	310/12
3,486,095	12/1969	Sherwood et al.	310/14
3,559,011	1/1971	Edwards	176/36 R
3,572,161	3/1971	Lichtenberger et al.	310/14

FOREIGN PATENTS OR APPLICATIONS

1,206,102	12/1965	Germany	176/36 R

Primary Examiner—Harvey E. Behrend

Attorney, Agent, or Firm—Harris G. Luther

[57] **ABSTRACT**

A nuclear reactor control rod anti-ejection lock for use with magnetic jacking type control rod drives and having a spring pressed pawl which ratchets to allow insertion of the control rod but prevents ejection or withdrawal unless the control rod drive is in an upper position or the latch mechanism of the drive is in latched position. The drive comprises two axially spaced axially movable drive members around the rod and magnets selectively alternately moving the members in two opposite directions along or with the rod. Each member carries a latch or gripper and an axially movable sleeve, selectively magnetically operated, to operate the latch to connect or disconnect the rod and respective drive member. A push rod connects each sleeve and the pawl and disables the pawl when either sleeve is in position to latch the control rod and a drive member. The stroke of the drive member may be made less than the stroke of the sleeve and a lost motion incorporated in the push rod connection so that the drive member will not disable the pawl.

15 Claims, 4 Drawing Figures

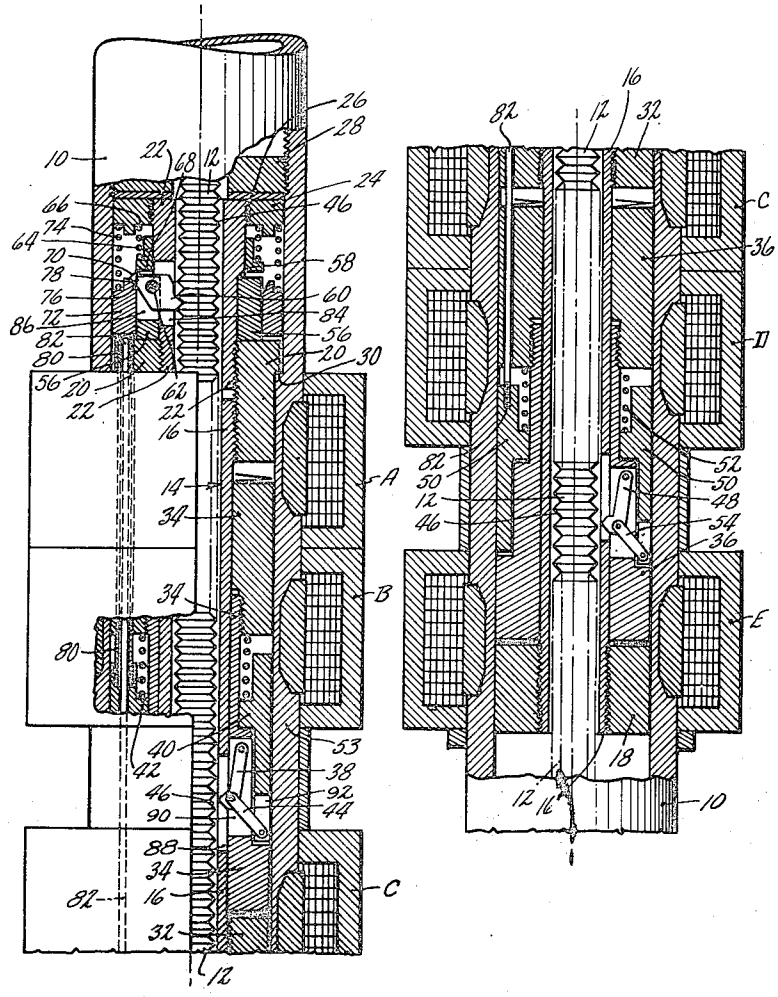
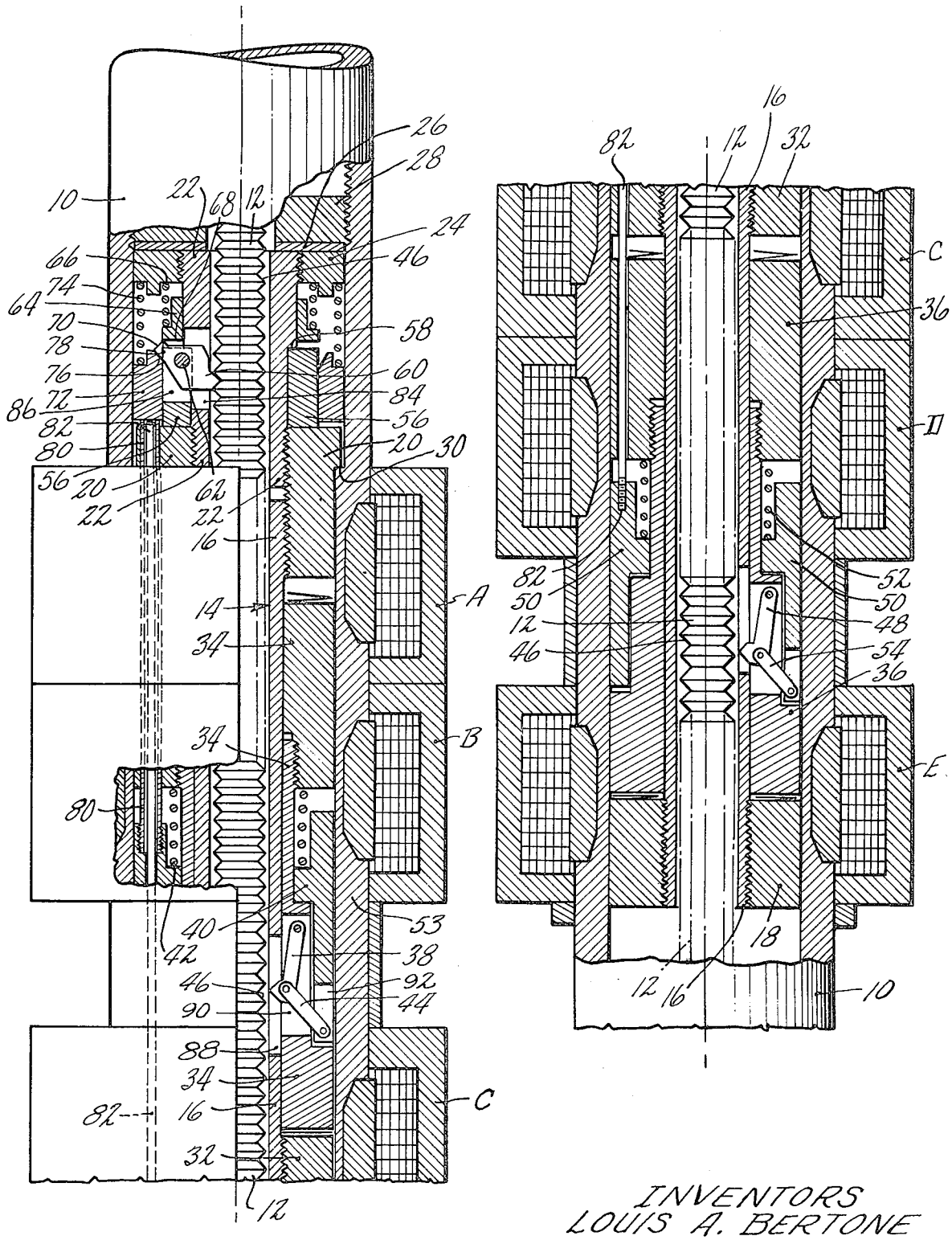


FIG_1



INVENTORS
LOUIS A. BERTONE
PETER F. BEHMKE

BY Harvey L. Luther
ATTORNEY

FIG. 2

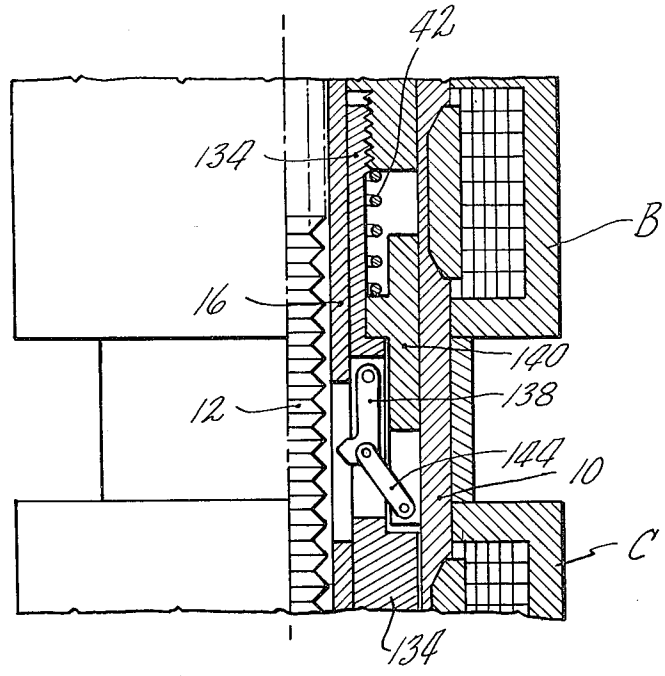


FIG. 3

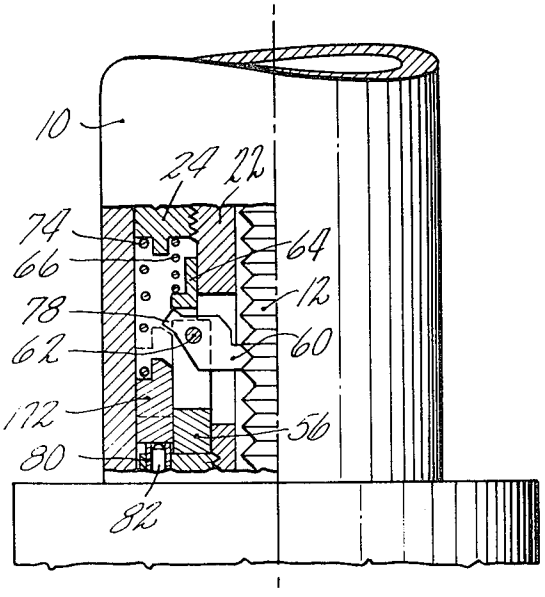
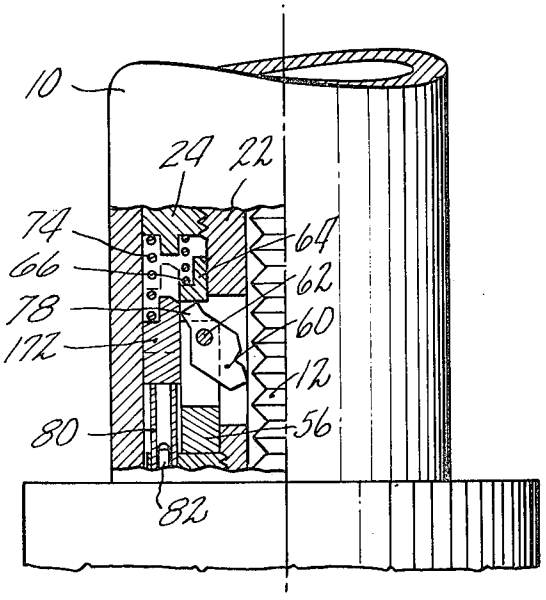


FIG. 4



INVENTORS
LOUIS A. BERTONE
PETER F. BEHMKE

BY Harris & Luther
ATTORNEY

ANTI-EJECTION LATCH

BACKGROUND OF THE INVENTION

This invention relates to nuclear reactors and particularly to control rod drive mechanisms of the magnetic jacking type. It prevents ejection of the control rod during an accident condition but allows scram of the control rod at any time.

In a magnetic jacking type control rod drive the control rod is moved through a plurality of stepping actions. Electromagnetic coils surround the control rod housing and are sequentially operated to perform a number of lifting or lowering steps. Certain coils will energize gripper assemblies which engage with axially spaced grooves on a control rod extension. Other coils will operate to lift or lower at least one of the gripper assemblies a short distance. Another gripper may be engaged to hold the control rod in this position so that the first gripper may be disengaged and lowered in preparation for gripping and raising another step. These grippers are arranged so as to disengage the control rod extension on loss of power, thereby permitting the reactor to be scrammed by lowering the control rod by gravity even though power is not available to the jacking means. This is accomplished by letting the control rod fall under the influnce of gravity.

In the event of a rapid pressure excursion within the reactor, it is possible that the control rods will be driven upwardly out of the core by that pressure. This will then result in a rapid power increase within the core and possible concomitant damage to the reactor and surroundings. If the magnetic jacking unit is engaged at the time of this pressure excursion, that unit itself will hold the control rods in the core. Should, however, the unit be de-energized, control rod ejection is possible. While it is desirable that this control rod ejection be prevented, it is important also that there be little or no resistance to a free fall of the control rods so that the reactor may readily be scrammed during an emergency situation.

German Pat. No. 1,206,102 issued June 16, 1966, to Franz Schreiber discloses a control rod moving mechanism having three separately actuated electromagnets. One electromagnet will force a holding latch into holding position, a second electromagnet will force the rod moving latch into a holding position with the rod moving member and the rod. A third electromagnet will actuate the rod moving member upward and at the same time release an anti-ejection latch so that the anti-ejection latch is always disabled or in non-holding position whenever the rod moving member is magnetically moved upwardly. This mechanism is entirely magnetically actuated and there is no direct connection, magnetic or otherwise, between the rod holding latch or the rod moving latch.

U.S. Pat. No. 3,480,807 issued Nov. 25, 1969, to R. E. Downs et al shows a similar structure except that the anti-ejection pawl has its own electromagnetic and also shows a modified structure in which the pawl is moved into and out of ratcheting relation by the gripper actuating mechanism. In this modified structure of this patent the ratchet is mounted on a pair of pivots both of which are movable axially of the linearly movable element and the ratchet is moved into ratcheting relation by the spring that actuates the grippers and has no independent means for moving the ratchet into ratcheting relation and accommodating the ratcheting action.

SUMMARY OF THE INVENTION

In this invention two magnetically actuated alternately operating rod moving members are provided each member carrying its own independently actuated latch or gripper mechanism for connecting the moving member with the rod or disconnecting the member from the rod. No separate holding latches are necessary as, in normal operation, one or the other of the moving latches or grippers is always engaged to connect the rod with one or the other of the moving members and the moving members have only a very limited movement. An anti-ejection pawl or lock, spring pressed into ratcheting relation with the control rod, is connected with a fixed portion of the control rod housing for the reactor vessel to prevent outward or retrograde movement of the rod when the pawl is in active position. The pawl or lock will ratchet to permit inward movement of the control rod. Mechanical mechanism is provided and connected with the latch operating mechanism of the rod moving members to act against the action of the pawl spring and disable the pawl, by moving it into an inactive position, by latching movement of the latch actuating mechanism of either of the rod moving means. This invention is shown in connection with a rod feeding or moving mechanism having five separate electromagnets; a single central electromagnet is used to pull the upper rod moving mechanism down and the lower rod moving mechanism up. Separate magnets are used for actuating each of the latch or gripper operating mechanisms of the moving members. A separate magnet is used for lifting the upper moving member and a separate magnet is used for lowering or pulling down the lower rod moving member.

An object of this invention is independent pawl actuating and gripper release mechanism including mechanism for disabling the anti-ejection pawls when the control rod feeding grippers are engaged.

Another object of this invention is mechanism engaging the anti-ejection pawl by movement of only the feeder latch or gripper operating mechanism to latch or gripper releasing position.

A further object is a mechanical connection having a lost motion between the anti-ejection pawl and the control rod feeder latch or gripper operating mechanism.

Other objects and advantages will be apparent from the following specification and the attached drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a side elevation, partially in section, and with parts broken away, of the anti-ejection pawl and the cooperating ratchet formed on the control rod and the actuating mechanism for the pawl.

FIG. 2 is a broken away partial sectional view showing a modification of a gripper and actuator having a longer stroke than that shown in FIG. 1.

FIG. 3 is a broken away partial sectional view of the ratchet pawl and showing the lost motion accommodating the longer stroke of FIG. 2.

FIG. 4 is similar to FIG. 3 but showing the ratchet pawl in disabled position.

DESCRIPTION OF DISCLOSED EMBODIMENT

This invention is shown in connection with a control rod drive or feeder similar to that shown and claimed in an application of P. F. Behmke for Gripper Type

Linear Motion Device Ser. No. 834,465 filed June 18, 1969, to which reference may be made for further details.

In the now preferred embodiment shown in the drawings, a casing or support **10** in the form of an air-tight tube is secured in air-tight relation at the lower end to the nuclear reactor housing not shown and is closed at the upper end to provide a hermetically sealed housing for the control rod **12** which extends into the reactor and is surrounded by the casing **10.** The control rod is axially movable in step-by-step motion inside of the casing **10** by selective actuation of solenoids A, B, C, D and E arranged outside of and around the casing **10.** A tubular member shown generally at **14** is positioned inside of the casing **10** and surrounding the control rod **12.** This tubular member **14** is secured at its upper end to the upper portion of the casing **10** and supports all of the internal operating mechanism for axially moving and holding the control rod. The control rod **12** is linearly axially slidable inside of the tubular member **14.** The tubular member **14** comprises a tube **16,** which may be of magnetic or non-magnetic material but is preferably of non-magnetic material, which is threaded into a sleeve **18** of magnetic material at the lower end and a sleeve **20** of magnetic material at the upper end. A tube **22** similar to tube **16** is threaded into the opposite side of sleeve **20** and at its opposite end it is threaded into a sleeve **24.** A washer **26** acting on the upper face of sleeve **24** is forced inward by nut **28** threaded into casing **10** to force sleeve **20** down against shoulder **30** in casing **10** and thus support the entire tubular member **14** in the casing **10.**

The sleeves **18** and **20** which are of magnetic material are thus secured in fixed position in the casing **10.** A sleeve **32** which is of magnetic material is also secured in fixed position on sleeve **16** of the tubular member **14** intermediate the sleeves **18** and **20.** Slidably mounted on the tubular member **14** is an upper rod feeder or moving member **34** of magnetic material having one end adjacent the sleeve **20** and the other end adjacent the sleeve **32** so as to be reciprocated between the two sleeves which will act as stops for the moving member and limits its movement. A lower feeder or moving member **36** is mounted for axial sliding movement on the tubular member **14** and has its upper end adjacent the sleeve **32** and its lower end adjacent the sleeve **18** for axial movement between the sleeves which will act as stops limiting such movement.

When solenoid A is energized moving member **34** is drawn upward towards sleeve **20** and when solenoid C is energized moving member **34** is drawn downward towards sleeve **32.** Energization of solenoid C will also cause moving member **36** to be drawn upward towards sleeve **32** and energization of solenoid E will cause moving member **36** to be drawn toward sleeve **18.** Thus solenoids A, C and E provide the means for selectively moving moving members **34** and **36** in either of two opposite directions between their respective stops.

A latch or gripper **38** is pivotally mounted on moving member **34.** A latch operating sleeve **40** is slidably, axially, movable on upper moving member **34** and is spring pressed downward by spring **42.** A link **44** is pivoted at one end to sleeve **40** and at the other end to latch or gripper **38** so that axial movement of the sleeve **40** relative to moving member **34** will force the latch or gripper **38** into gripping relation with the control rod **12** and connect member **34** with rod **12** or withdraw the latch so as to disconnect the moving member **34** from the control rod **12.** Control rod **12** is provided with suitable projections or ratchet teeth **46** coacting with the latch **38** to provide the necessary gripping relation. When the latch **38** is in gripping relation with the rod **12** axial movement of the moving member **34** will carry the rod **12** along with it to move the rod **12** in the selected direction and will limit movement of rod **12** to that of member **34** between its cooperating stops. The lower moving member **36** has a pivoted latch **48,** a latch operating sleeve **50,** a sleeve actuating spring **52** and a link **54** connecting the sleeve **50** and the latch **48** mounted thereon and operating the same as that described in connection with the upper moving member **34.** Energization of solenoid B will draw the sleeve **40** which is of magnetic material toward the upper portion of moving member **34** to force the latch **38** into gripping relation with the rod **12** and the spring **42** and gravity will force the sleeve **40** downward to release the gripping action of the latch **38.** Similarly energization of solenoid D will draw the sleeve **50** which is of magnetic material upwardly against the action of spring **52** to the upper portion of moving member **36** to force the latch **48** into gripping relation with the rod **12** and the spring **52** and gravity will force the sleeve **50** downward to release the latch **48** from such gripping relation.

On tube **22,** at the upper portion of tubular member **14,** a sleeve **56** is secured to tube **22** by being pinched between shoulder **58** on tube **22** and the sleeve **20,** which is threaded onto tube **22.** The pawl **60** is pivotally mounted on sleeve **56** by means of a pin or guide **62.** A sleeve **64,** axially slidably mounted on tube **22,** is spring pressed in one direction by spring **66** to force the lower face surface **68** of the sleeve **64** against a projection **70** of the pawl **60** to force the pawl **60** inwardly into ratcheting engagement with the projections or ratchet teeth **46** on the rod **12.**

When the rod **12** is forced inward, say by gravity, the projections or ratchet teeth **46** will force the pawl to turn about its pivot **62** away from the rod **12** and against the action of spring **66** and allowing the rod **12** to continue its inward motion. If the rod **12** should attempt outward or upward movement the projections **46** would tend to turn the pawl **60** in the opposite direction forcing the pawl more tightly against the rod **12** and thus prevent the outward movement.

In order to permit outward movement of the control rod **12** means are provided for disabling the pawl **60,** such means comprises a sleeve **72** slidably mounted on the sleeve **56** and spring pressed downward by a spring **74.** The sleeve **72** has a surface **76** adjacent its upper end coacting with the lower surface of an outwardly extending arm **78** integral with the pawl **60.** Upward movement of the sleeve **72** against the action of spring **74** will turn the pawl **60** about its pivot or guide **62** and against the action of spring **66** and move the pawl **60** out of contact with the projections **46** to allow free movement of the control rod **12** in either direction as far as the pawl **60** is concerned. A tubular push rod **80** extends through fixed sleeve **20** and through upper moving member **34** and is secured at its lower end, as by threading, to the latch operating sleeve **40.** The tubular push rod **80** terminates at its upper end in a position adjacent the lower surface of the sleeve **72** in such a position that actuation of the latch operating sleeve **40** to move the latch **38** into gripping relation with the rod **12** will move the sleeve **72** upward and thus disable

the latch 60 by moving it into a position clear of the projections or ratchet teeth 46.

A push rod 82 connected at its lower end to the latch operating sleeve 50, as by being threaded into that sleeve, extends upwardly through lower moving member 36, fixed sleeve 32, through upper moving member 34 and latch operating sleeve 40 and through the tubular push rod 80 and terminates adjacent the lower surface of the pawl disabling sleeve 72 in such a position that movement of the lower latch operating sleeve 50 upward to move the latch 48 from an inoperative position to a gripping position will push the sleeve 72 upward and disable the pawl 60.

In the embodiment shown in this application, the push rods 80 and 82 are arranged so that upward movement of either upper latch operating sleeve 40, lower latch operating sleeve 50, upper moving member 34 or lower moving member 36 will disable the pawl 60. In such an arrangement the sequence of operation of the several solenoids assists in assuring that the pawl 60 will be disabled only when the drive latches 38 or 48 are engaged.

Starting from the position shown in the drawing, which is the scram position in which all the solenoids are de-energized so that the control rod 12 is free to drop of its own weight under the influence of gravity and both of the upper and lower moving members 34 and 36 and both of the upper and lower latch operating sleeves 40 and 50 are in the lower position, in order to lift the control rod 12, the solenoid D would first be actuated to lift operating sleeve 50 and force the latch member 48 inward to grip the rod 12 and connect the lower sleeve member 36 with the rod 12. Actuation of solenoid D will lift latch operating sleeve 50 and force push rod 82 upward moving sleeve 72 upward and disabling the pawl 60 so that actuation of solenoid C can lift the control rod 12. Solenoid C would then be actuated to lift the lower moving member 36 and the rod 12 latched thereto. Solenoid B would then be actuated to lift the latch operating sleeve 40 and force the upper latching members 38 into gripping relation with the rod 12 so that now both latches are in gripping relation. Solenoid D is then de-energized to release the latches 48 and allow latch operating sleeve 50 to drop and solenoid C is de-energized. Solenoid A is then energized to raise upper moving sleeve 34 together with the rod 12 and solenoid E is energized to draw the lower moving member 36 down. Solenoid D is now energized to again activate the latches 48 so that both latches are now in gripping position. Solenoid B is then de-energized to release the latches 38 and solenoids A and E are de-energized. Solenoid C is then energized to lift the lower moving member 36 and the rod 12 and begin another cycle. It will thus be obvious that the rod can be lifted in a step-by-step motion and always secured against unwanted motion in either direction as long as the solenoids are operating. Whenever the solenoids stop operating both the upper and lower moving members and the upper and lower latch operating sleeves will drop to the lower position and the pawl 60 will then be free to assume its active position under the action of spring 66. In the position shown in the drawing the control rod is at its lowest position.

An explanation of how the control rod can be lifted has been given above. It is obvious that the control rod can be lowered in a step-by-step motion by reversing the sequence and energization of the several solenoids.

In the embodiment shown in FIG. 1 the geometry is such that the moving members 34 and 36 have a motion substantially equal to that of the latch operating sleeves 40 and 50 so that upward movement of either or any of these members will disable the pawl 60.

In the modification shown in FIGS. 2, 3 and 4 the geometry selected is similar to that shown in the Behmke Application Ser. No. 834,465 referred to above in which the motion of each latch operating sleeve is greater than that of the moving members. The structure shown in FIGS. 2, 3 and 4 is essentially the same as the structure of FIG. 1 except that parts have been modified to provide a stroke for the gripper actuating means greater than that of the rod moving members and some lost motion is provided. In FIGS. 2, 3 and 4, parts corresponding to those in FIG. 1 are given the same number and those parts which correspond except for a change in size or geometry are given a number 100 greater than the corresponding part in FIG. 1. In FIG. 2 the link 144 has been lengthened and the pivots have been relocated on the gripper 138 to produce a longer stroke of the gripper actuating sleeve 140 in moving the gripper from a gripping or connected relation with the rod 12, in which the gripper engages one of the axially spaced teeth 46, to a release or ungripped position in which the gripper 138 is removed from the teeth and the rod 12 is disconnected from the rod moving sleeve 134. Additional clearance has been provided between the upper end of actuator sleeve 140 and moving member 134 to permit the additional stroke. The spacing between moving member 134 and the stop sleeve 20 and the stroke of moving member 134 remains the same so that in the FIG. 2 modification the stroke of the gripper actuator 140 is greater than the stroke of the associated rod moving element 34. The same changes are made in the gripper linkage, gripper actuator and rod moving member in the lower rod feeding group in the FIGS. 2, 3 and 4 modification.

The axial spacing of the projections or ratchet teeth 46 on the control rod 12 will ordinarily determine the stroke to be provided in the rod moving mechanism, the stroke being equal to or slightly more than the tooth spacing. Hence the same result of having the stroke of the gripper actuator longer than that of the rod feeder can be accomplished by making the tooth spacing and the stroke of the rod feeder smaller than that of the gripper actuator.

The ratchet disabling mechanism shown in FIGS. 3 and 4 has been modified from that shown in FIG. 1 to provide a lost motion in the mechanical connection between the ratchet pawl and each of the gripper actuating sleeves by shortening the sleeve 172 so that it is in an inactive range shown in FIG. 3 out of contact with the projection 78 of the ratchet pawl 60. When the latch operating sleeves are in ungripping position and the rod moving sleeves are in their lowermost position the sleeve 172 is in the retracted position shown in full lines in FIG. 3 and the full motion of the rod moving sleeves 34 and 36 will be taken up by the lost motion and the rod moving sleeves will move the sleeve 172 only from the retracted position to an intermediate position shown in dotted lines in FIG. 3 and will not be able to disable the ratchet 60 even in their uppermost position.

The push rods 80 and 82 are not physically attached to the sleeve 72 or 172 or the pawl 60 but are operatively mechanically connected thereto because of the

mechanical contact which renders the pawl inoperative. The upper ends of the push rods **80** and **82** are positioned to provide a lost motion between the sleeve **172** and projection **78** of pawl **60** substantially equal to the motion of the moving members **34** and **36** so that upward movement of the moving members alone with the latch operating sleeves in the ungripping position would move the sleeve **172** only to an intermediate position out of contact with pawl **60** and would not disable the pawl **60** although they would carry the latch operating sleeves **40** and **50** with them. The latch operating sleeves **140** and **50** (as modified) having a longer travel than the rod moving members **34** and **36** have sufficient motion to overcome the lost motion in the pawl disabling mechanism and lift the disabling sleeve **172** into a disabling position shown in full lines in FIG. **4** into contact with and past the projection **78** and disable the pawl **60** even with the moving members **34** and **36** in their lower position. With the moving members **34** and **36** in their upper position the latch operating sleeves in moving to gripping position would move the disabling sleeve from the intermediate position shown in dotted lines in FIG. **3** past the disabling position shown in full lines in FIG. **4** to the extreme disabling position shown in dotted lines in FIG. **4.** Full motion of the rod moving sleeves would then with the latch operating sleeves in gripping position move the disabling sleeve only between the extreme disabling position and the disabling position and would not release the pawl to its active position. The single pivot or guide **62** or the pawl **60** is fixed to the sleeve **56** against axial or transverse movement and hence is fixed against movement with respect to the control rod support. The sleeve **172** will turn the pawl about said pivot against the action of the ratchet spring **66** in disabling the pawl and by sliding past the projection **78** the inner surface of sleeve **172** will act as a stop against which the pawl will be held in disabled position by the spring **66.** The lost motion could be between the ends of the push rods **80, 82** and the disabling sleeve **172** but is now preferred between the sleeve **172** and the arm **78** on the pawl **60.** With such a geometry the pawl **60** would be disabled only when one or both of the latches **38** and **48** were in gripping relation with the rod **12.**

In the modification shown in FIG. **1** the spring **74** acting through the disabling sleeve **72** and the push rods **80** and **82** will assist springs **42** and **52** in urging the latch operating sleeves **40** and **50** and the latches **38** and **48** into unlatching position and will also urge the upper and lower moving members **34** and **36** into their downward position. This same function will be present in the modification of FIGS. **2, 3** and **4** in which the latch operating sleeve has a greater stroke than the associated moving member where the lost motion is provided between the disabling sleeve **172** and the arm **78** of the pawl **60.** If the lost motion is provided between the upper ends of the rods **80** and **82** the lower surface of the disabling sleeve **72** by providing a stop for the downward motion of the sleeve **72** then the spring **74** would assist downward movement of moving members **34** and **36** only when the latch operating sleeves **40** or **50** were in latching position and would assist springs **42** and **52** for only a portion of their downward stroke.

While only a single pawl **60** and a single latch **38** and a single latch **48** and a single push rod **80** and a single push rod **82** have been described, it should be understood that two or more such pawls, rods or latches, preferably at least three of each, may be arranged around the rod **12.**

The tube **22** is provided with a slot **84** extending therethrough to permit passage of the pawl **60** and the sleeve **56** has a similar slot therethrough to receive the pawl **60** and permit rotation thereof about its pivot **62.** The tube **16** is provided with a slot **88** to permit passage of the latch **38** therethrough and the latch **38** is mounted in a slot **90** in the upper moving member **34.** The latch operating sleeve **40** is slotted at **92** to receive the link **44** and permit its pivotal movement. Tube **16,** lower moving member **36** and lower latch operating sleeve **50** are provided with similar slots.

While the mechanism shown utilizes two axially spaced feeding members it should be understood that the lower feeding member could be replaced by a holding latch and the invention of this application used to disable the anti-ejection pawl when either the feeding latch or the holding latch were engaged and to release the pawl to prevent outward movement or ejection of the rod **12** whenever both the feeding latch and the holding latch were inactive.

While we have illustrated and described a preferred embodiment of our invention it is to be understood that such is merely illustrative and not restrictive and that variations and modifications may be made therein without departing from the spirit and scope of the invention. We therefore do not wish to be limited to the precise details set forth but desire to avail ourselves to such changes as fall within the purview of the claims.

What we claim is:

1. In combination an axially movable rod having rachet teeth, a support for said rod, a pawl, a single guide for said pawl fixed with respect to said rod support and supported against axial movement with said rod, pawl urging means moving said pawl on said single guide into ratcheting relation with said rod teeth to prevent axial movement of said rod in a selected direction, an axially movable rod moving member, latch means carried by said rod moving member for gripping said rod and connecting said rod and said moving member, latch operating means also carried by said rod moving member and movable in one direction with respect to said moving member for placing said latch into gripping relation with said rod and including means urging said latch in the opposite direction and out of gripping relation with said rod, disabling means movable into and out of contact with said pawl, said disabling means movable into contact with said pawl by said latch operating means moving in said one direction and by said contact moving said pawl on said single guide, against the action of said pawl urging means, out of ratcheting relation with said rod, said disabling means movable out of contact with said pawl by movement of said latch operating means in said opposite direction so that said pawl is free to ratchet on said single guide.

2. A combination as claimed in claim **1** in which said disabling means includes mechanical mechanism operatively connecting said latch operating means and said pawl and has an active position in contact with said pawl preventing movement of said ratcheting means and an inactive position in which said mechanism is out of contact with said ratcheting mechanism.

3. A combination as claimed in claim **2** in which said mechanical mechanism includes a lost motion, and a separate spring, separate from both said pawl urging and said latch urging means, urging said disabling

means through said lost motion to said inactive position.

4. A combination as claimed in claim 1 in which said pawl is a pivoted pawl having a single pivot fixed on said support, said pawl urging means is a spring urging said pawl about said fixed pivot and said disabling means is a mechanical connection forcing said pawl about its fixed pivot against the urging of said pawl spring and forming a stop preventing movement of said pawl by said spring.

5. A combination as claimed in claim 1 including two separate, selectively, alternately operable, rod moving members and a separate latch operating means for each member, and in which said disabling means movable by said latch operating means includes means individually actuated by each of said latch operating means for moving said pawl out of ratcheting relation with said rod.

6. In combination with a control rod, rod moving means having a limited stroke for selectively axially moving said rod a limited distance in either of two opposite directions, connecting and disconnecting means mounted on and movable with, and relative to, said rod moving means and having a stroke longer than said limited stroke relative to said rod moving means for selectively connecting said moving means with, and disconnecting said moving means from, said rod, ratchet means preventing movement of said rod in one direction, disabling means operatively connected with said connecting and disconnecting means and movable by both said rod moving means and said connecting and disconnecting means and requiring a predetermined stroke to move said disabling means to a disabling position for disabling said ratchet means, said disabling means movable through said preselected stroke to said disabling position only by connecting movement of said connecting and disconnecting means, said limited strokes of said rod moving means being insufficient to move said disabling means to said disabling position by movement of said rod moving means, so that said ratchet means is disabled only when said connecting means is connected.

7. In combination with a linearly axially movable control rod, a control rod support, moving means for selectively moving said rod, movable means for selectively connecting said moving means with, and disconnecting said moving means from, said rod, ratchet means operatively connecting said support and said rod and having an active and an inactive position and in said active position ratcheting and preventing movement of said rod in one direction, spring means continuously urging said ratchet means from said inactive into said active ratcheting position, stop means movable into and out of contact with said ratchet means and having a stop position in contact with said ratchet means preventing movement of said ratchet means into active position and means, operably connected with, and actuated responsive to disconnecting movement of, said movable means, moving said stop means from its stop position to a position out of contact with said ratchet means and releasing said ratchet means for movement by said spring from said inactive to said active position.

8. A combination as claimed in claim 7 including two separate selectively operable moving means each having its own separate connecting and disconnecting means and means actuated by each of said connecting and disconnecting means separately moving said stop means and disabling said ratchet means.

9. In combination a control rod, control rod feeding mechanism having two separate, selectively operable gripper mechanisms coacting with said control rod, a ratchet mechanism coacting with said control rod for preventing outward movement of said control rod and means independently actuated by each said gripper mechanisms for disabling said ratchet mechanism.

10. A combination as claimed in claim 9 in which the means actuated by each said gripper mechanism includes a mechanical connection connecting each gripper mechanism and said means disabling said ratchet mechanism.

11. In combination a linearly movable element having a plurality of axially spaced teeth, element feeding means movable through a limited stroke linearly with and axially of said element to move said element in either of two opposite directions, a gripper, carried by said feeding means, movable into and out of gripping relation with said element, gripper actuating means mounted on said feeding means and movable through said limited stroke linearly with, and by, said element feeding means, said gripper actuating means additionally separately movable, through a longer stroke than said limited stroke, relative to said element feeding means to move said gripper into and out of gripping relation with said element, ratchet means coacting with said teeth preventing movement of said element in one direction, ratchet disabling means operatively connected with said gripper actuating means and movable through said limited stroke by movement of said element feeding means and movable through said longer stroke by said gripper actuating means alone, said gripper actuating means in moving said gripper out of gripping relation with said element moving said disabling means from a disabling position, in which said disabling means disables said ratchet means, to a position restoring said ratchet to ratcheting condition, said limited stroke of said feeding means being less than that required to move said disabling means to a disabling position and disable said ratchet when said gripper actuating means has moved said gripper out of gripping relation with said element so that said ratchet is effective as a ratchet in every position of said element feeding means when said gripper is out of gripping relation with said element.

12. A combination as claimed in claim 11 in which said disabling means has a lost motion equal at least to said limited stroke through which said disabling means is ineffective.

13. A combination as claimed in claim 11 including a support for said rod and in which the ratchet is mounted on a pivot fixed with respect to said support and is rotated about said pivot into ratcheting relation with said teeth by a ratchet spring and said disabling means comprises a device movable from out of contact into contact with said ratchet to move said ratchet, about said pivot, against the action of said spring and out of ratcheting relation with said teeth.

14. A combination as claimed in claim 11 including a second gripper spaced axially of said first mentioned gripper, gripper actuating means movable through a stroke longer than said limited stroke to actuate said second gripper to move said gripper into and out of gripping relation with said element, and means separate from said first mentioned gripper actuating means mov-

able by said second gripper actuating means for moving said disabling means to a disabling position.

15. A combination as claimed in claim **14** including a second element moving means spaced axially of said first mentioned moving means and movable through the same limited stroke as and, alternately with, said first mentioned moving means to move said element linearly axially in steps, said second gripper being carried by said second moving means and said second gripper actuating means being mounted on said second moving means and having a stroke longer than said limited stroke.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,902,963

DATED : September 2, 1975

INVENTOR(S) : Louis A. Bertone, Peter F. Behmke

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 26, "influnce" should be --influence--

Column 1, line 58, "electromagnetic" should be --electromagnet--

Column 5, line 31, after "lift" insert --latch--

Column 8, line 5 of Claim 2, cancel "ratcheting means" and insert thereof --pawl--

Column 8, line 7 of Claim 2, cancel "ratcheting mechanism" and insert thereof --pawl--

Signed and Sealed this

eleventh Day of *May 1976*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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